Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band	)	GN Docket No. 12-354

COMMENTS OF BARON SERVICES, INC.

Baron Services, Inc. ("Baron") submits these comments in response to the Notice of Proposed Rulemaking ("NPRM") released December 12, 2012 in the above-captioned proceeding.[1] In the NPRM, the Commission proposes to create a new Citizens Broadband Service in the 3550-3650 MHz band ("3.5 GHz Band"). Baron has a significant interest in this proceeding because it manufacturers S-band weather radar systems certified by the Commission to operate within the 3500-3600 MHz frequency range with an authorized power level of 1 megawatt.[2] Baron therefore strongly urges the Commission to adopt adequate technical and service rules to ensure that any reallocation of the 3.5 GHz Band does not cause harmful interference to these radar systems. Although Baron understands the importance of identifying additional spectrum for wireless broadband applications, the Commission should not permit new uses of spectrum that could seriously impact other services, particularly where, as here, harmful interference would seriously undermine a service used to help ensure public safety.

Since its inception more than two decades ago, Baron's primary goal has been to deliver meteorological tools that aid in the protection of life and property. A leader in radar development, construction, and installation, Baron holds numerous U.S. patents for its innovations in storm tracking, radar, and weather alerting technology. Baron currently has an installed base of about 160 radars systems used primarily by broadcast television stations. As

[1] *See Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Notice of Proposed Rulemaking and Order, 27 FCC Rcd 15594 (2012).
[2] *See* Equipment Authorization Identification Nos. NX5VHDD-1000S and NX5KHDD-1000S.

demonstrated in the attached map ("Baron: Broadcast Radar Installations Coverage"), these radar systems cover approximately 90% of the U.S. population. Although these radar systems operate in either the C-band or the X-band, most of these systems currently utilize legacy equipment, and therefore likely will be upgraded in the relatively near future. As detailed below, in order for these broadcasters to take advantage of cutting-edge, next generation radar technology, and thereby provide crucial public safety information to their viewers, as part of these radar upgrades many may desire to transfer to S-band radar operations in the 3500-3600 MHz frequency range.

During the past several years, Baron has conducted pioneering work in the field of dual-polarization radar technology. Specifically, Baron has been working with L-3 STRATIS to upgrade 171 Next Generation Weather Radar ("NEXRAD") systems to dual-polarization technology for the National Weather Service ("NWS"). The attached map ("NEXRAD: Dual-Polarization Upgrade Status") demonstrates the expansive coverage of these S-band radar systems, which are currently licensed for operations in the 2.7-3 GHz frequency range. In addition to its work upgrading these NEXRAD systems, Baron has developed a commercial dual-polarization radar system which, as noted, is certified to operate in the 3500-3600 MHz band. Baron is currently finalizing the sale of two such systems to broadcast television stations that reach a population of over 8 million people, and expects robust future demand for these systems because of the substantial advantages of operating an S-band dual-polarization radar system. Further restrictions on the useable portion of this band will result in reduced areas of availability and create uncertainty for potential broadcaster adoption. In fact, both stations planning to file license applications for S-band operating authority have temporarily delayed their projects as a result of this rulemaking proceeding.

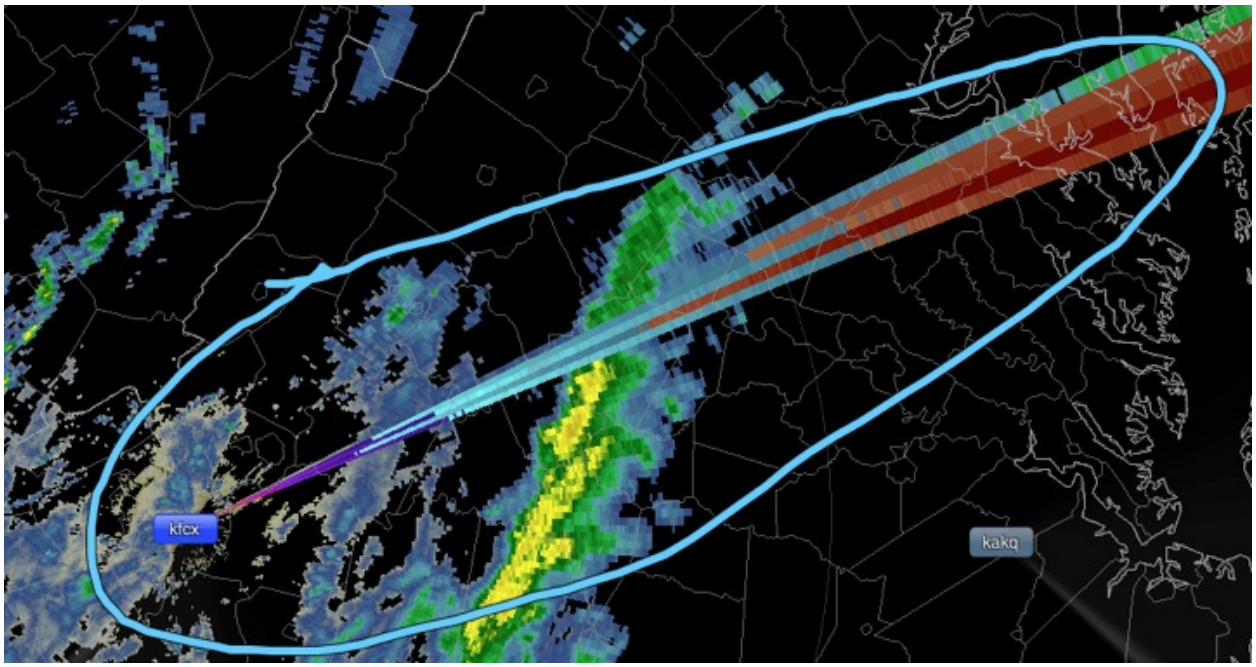
Radar systems employing dual-polarization technology represent a significant upgrade as compared to legacy radar systems. In contrast to traditional radar systems, which transmit a single horizontally-oriented radar pulse, dual-polarization radar systems also transmit a second,

vertically-oriented pulse, which allows for far more accurate weather forecasts. Specifically, dual-polarization allows a radar's signal processor to make direct measurements of the size, shape, and moisture of hydrometeors (*i.e.*, the drops and particles that make up precipitation). Because a dual-polarization radar processor can measure the shape of hydrometeors, it can calculate the type of precipitation that may be expected. In this way, the guesswork needed for a meteorologist to accurately distinguish between, for example, hail and heavy rain, or snow and freezing rain, is eliminated. In addition, dual-polarization radars can more accurately forecast precipitation rates, which permits far more accurate predictions regarding the potential for flooding or significant snow accumulation. In fact, some have estimated that dual-polarization radars are up to 10 times more accurate with respect to the amount of expected precipitation.

These substantial benefits from the use of dual-polarization radar systems are further increased by operating in the S-band. Compared to C-band radar operations, the S-band frequencies allow for greater penetration, which, for example, allows radars operating on this spectrum to see into the heart of a storm, and thereby more accurately gauge the true potential of any storm system. Radar systems operating in the C-band also require significantly more power than those operating in the S-band. Moreover, the 3500-3600 MHz portion of the S-band represents a particularly ideal atmosphere for weather radar operations, as evidenced by NWS's expressed desire to eventually relocate its NEXRAD radar installations to this portion of the S-band. In order to ensure these substantial public interest benefits, and to prevent stranding the good faith investments made in reliance on the current allocation for the 3.5 GHz Band and the Commission's grant of equipment authorization to Baron, the Commission must adopt technical and service rules that adequately prevent the introduction of harmful interference from any new terrestrial operations introduced in the 3.5 GHz Band.

Baron believes that a brief overview of radar technology will assist the Commission in formulating this necessary regulatory framework for Citizens Broadband Service operations in

the 3.5 GHz Band. As detailed in the NTIA's Fast Track Report, radar systems are highly sensitive to interference.[3] Radar systems direct transmitted radio energy toward small, remote objects and then receive and process reflections of small portions of the transmitted energy returned from the desired objects. In order to receive these "echoes," radars must employ very sensitive receivers. Although radar systems include interference rejection ("IR") capabilities, this feature only works against low duty cycle, pulsed, asynchronous interference. Thus, while the IR feature can reject or suppress interference into a radar receiver from co-channel transmissions from other radars, it is not effective against communication-signal interference because such interference typically is of much higher duty cycle than radars. The picture below, which is a screen shot of a NEXRAD weather radar system, aptly demonstrates the significant potential for harmful interference from an unlicensed WiMAX mobile device.



As noted in the Fast Track Report, because radar systems are highly sensitive to interference, in order to protect co-channel radar operations – here, those operating in the 3550-

[3] *See* NTIA, *An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, 4200-4220 MHz, and 4380-4400 MHz Bands*, p. 4-6 (rel. Oct. 2010) ("Fast Track Report").

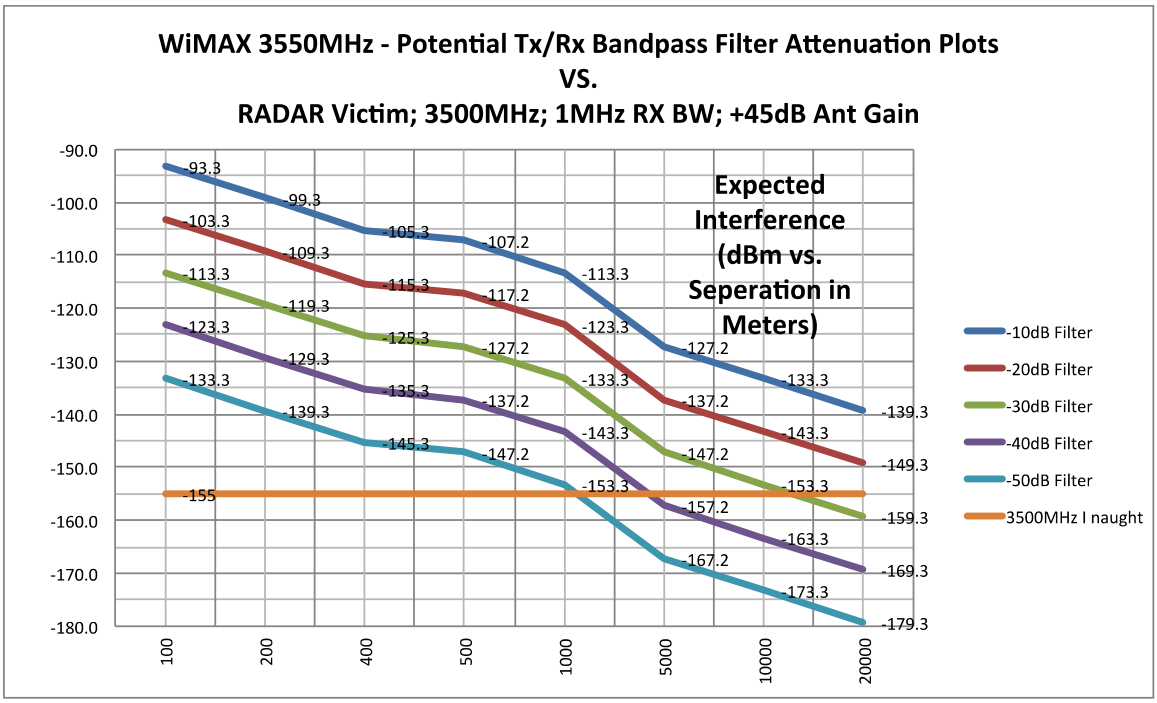
3600 MHz frequency range – from harmful interference, the Commission will need to establish a substantial geographic exclusion zone around each radar site, within which neither Citizens Broadband Service base stations nor mobile devices may operate on the same frequencies as these radar systems. With respect to the necessary size of these exclusion zones, Baron's preliminary analyses indicate that its S-band radar systems most closely resemble the ground-based radar 3 systems analyzed in the Fast Track Report.[4] However, the Fast Track Report does not appear to take into account the receiver sensitivity and high gain of weather radar antennas necessary to detect hydrometeors (*e.g.*, snowflakes) located 250 miles or more from the radar site. For instance, the NTIA's tables are based on a U.S. Navy shipboard air traffic radar system with an antenna gain of 34.5 dBi and a receiver sensitivity of -109 dBm. In contrast, Baron's S-band radar system has an antenna gain of 45 dBi and a receiver sensitivity of -111 dBm, which means that it is 12 dB more sensitive than the shipboard radar system analyzed by the NTIA. Thus, the exclusion zones necessary to adequately protect Baron's radar systems likely would need to be larger than those indicated in the Fast Track Report.

Baron's radar systems also would be highly susceptible to interference caused by the out-of-band emissions ("OOBEs") of adjacent-channel communications transmissions.[5] Baron therefore urges the Commission to also adequately address this form of harmful interference, which will require a combination of exclusion zones and the mandatory inclusion of narrow filters in both Citizens Broadband Service base stations and mobile devices. In this respect, Baron notes that stringent OOBE limits would significantly decrease the size of the requisite exclusion zones. The following chart demonstrates this relationship between OOBE limits and

[4] *See id.* at 4-82 (Table 4-72) and 5-4 (Table 5-2).

[5] *See* NPRM, 27 FCC Rcd at 15637 ("Transmissions originating in the 3.5 GHz Band may cause harmful interference to other services operating in the adjacent bands."); *id.* at 15637-38 ("Even though small cells are aimed to transmit at low EIRP, once they operate at the close proximity of the frequency band edge, out-of-band emission (OOBE) may cause interference into the neighboring channels or neighboring bands that are providing other services.").

the necessary geographic separations, assuming a 50 MHz offset between the Citizens Broadband Service transmitters and Baron's weather radar systems.



This chart clearly demonstrates that an OOBE limit of 43 + 10 $\log_{10}$ (P) dB,[6] which can be translated into a power spectral density of -13 dBm/MHz, would be woefully insufficient absent large exclusion zones around the radar sites.[7] Specifically, even with a 50 MHz offset, this OOBE limit for Citizens Broadband Service transmitters would require an exclusion zone around each radar site well in excess of 20 kilometers. Moreover, even a more stringent OOBE limit of -20 dBm/MHz would require exclusion zones exceeding 20 kilometers, and an OOBE limit of -30 dBm/MHz would require exclusion zones of approximately 12.5 kilometers. In contrast, assuming an offset of 50 MHz, an OOBE limit of -40 dBm/MHz would reduce the

[6] *See id.* at 15638.

[7] Although the Commission only requires compliance with a -13dBm/MHz OOBE limit in the 3650-3700 MHz band, and is unaware of any OOBE issues with adjacent bands, in the NPRM the Commission recognizes that this OOBE limit likely would be insufficient for Citizens Broadband Service transmissions in the 3.5 GHz Band. *See id.* ("[T]he current deployment in 3650-3700 MHz band is subject to geographic protection requirements for federal and FSS facilities and there is also a coordination requirement, which may be why there is no interference issue.").

necessary exclusion zone to less than 5 kilometers. Baron therefore suggests that the best approach may be for the Commission to adopt a stringent OOBE limit in conjunction with smaller, but sufficient, exclusion zones, which would be consistent with the Commission's desire "to reduce any exclusion zones through technical and operational parameters…"[8] Otherwise, as demonstrated by the attached maps, even if only a portion of the current broadcaster and NWS radar installations transition to the 3500-3600 MHz band in order to access the benefits of dual-polarization radar operations on this spectrum, Citizens Broadband Services would be effectively prohibited in many parts of the country.

Moreover, this approach would not unduly burden 3.5 GHz Band users or equipment manufacturers because compliance with a stringent OOBE limit can be accomplished by installing filters in Citizens Broadband Service base stations and mobile devices that, with the benefit of economies of scale, likely would add only a few dollars to equipment costs. This type of filter already exists for other spectrum bands, so it could easily be reconfigured for use in Citizens Broadband Service devices. At the same time, because a stringent OOBE limit would substantially decrease the size of the necessary exclusion zones, this approach would not place any material limits on the areas within which Citizens Broadband Service devices could otherwise operate. And, notably, these small exclusion zones would not be located in high traffic areas because Baron's radar systems will only be located well outside metropolitan areas (perhaps 30-40 miles outside of the relevant downtown area).

In sum, Baron strongly urges the Commission to establish a regulatory framework that fully protects all future S-band weather radar systems operating within the 3500-3600 MHz band from the harmful interference that otherwise would arise from Citizens Broadband Service operations in the 3.5 GHz Band. Specifically, the Commission should: (1) establish substantial exclusion zones to prevent interference to co-channel radar operations; and (2) impose a

[8] *Id.* at 15631.

stringent OOBE limit in combination with smaller exclusion zones to prevent interference to adjacent channel radar operations. By doing so, the Commission would promote the public interest by ensuring the continued viability of these advanced weather radar systems relied upon by the public while also increasing the amount of spectrum available for wireless broadband services.

Respectfully submitted,

BARON SERVICES, INC.

By: /s/.
Bill Walker
Vice President, Chief Engineer
Baron Services, Inc.
4930 Research Drive
Huntsville, AL 35805
Phone: 256-881-8811
Email: Bill.Walker@baronservices.com

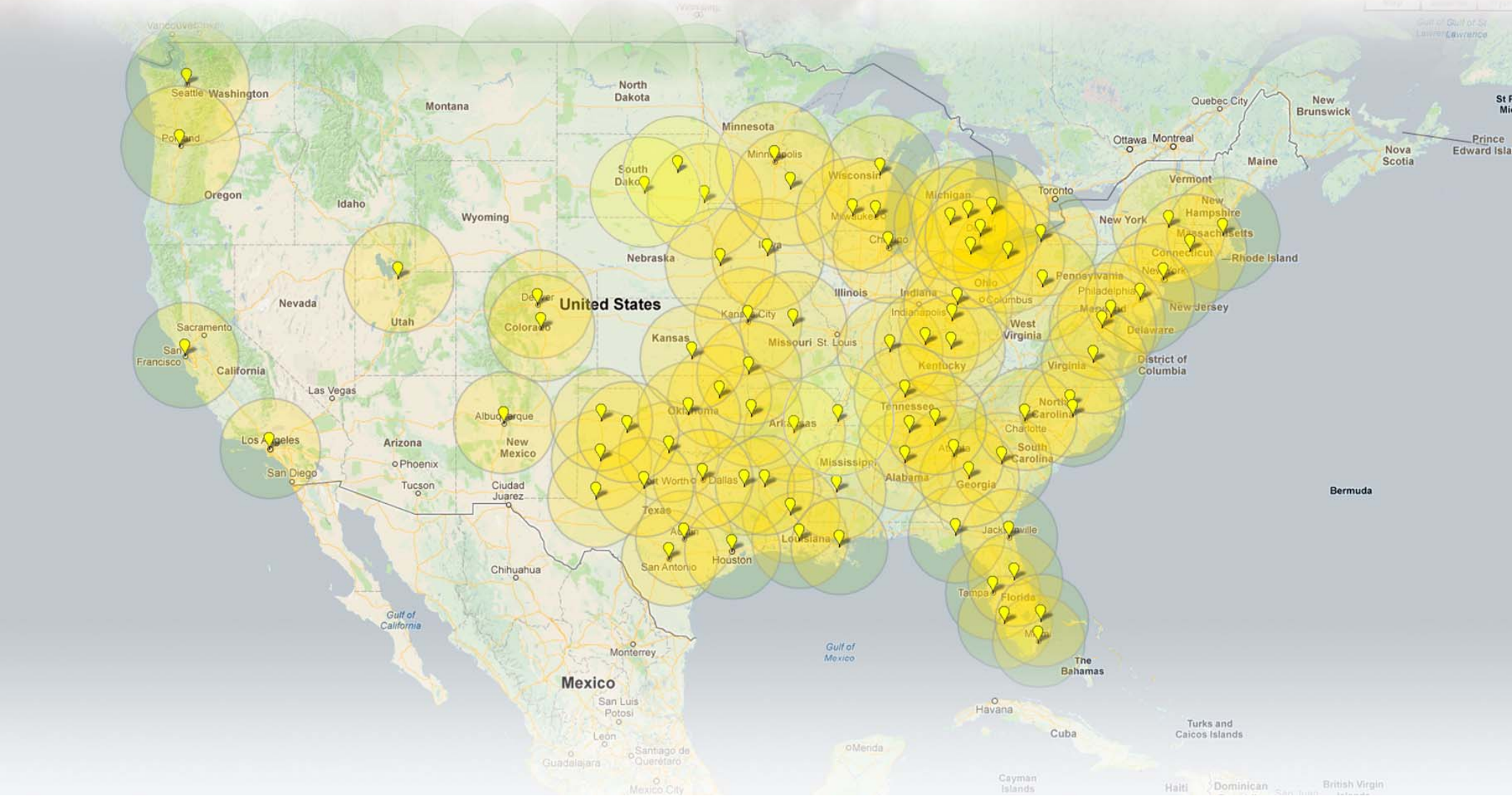
BARON SERVICES, INC.

By: /s/.
George Y. Wheeler
Leighton T. Brown
Holland & Knight LLP
800 17th Street, N.W., Suite 1100
Washington, DC 20006
Phone: 202-955-3000
Email: george.wheeler@hklaw.com
Its Attorneys

February 20, 2013

BARON

BROADCAST RADAR INSTALLATIONS COVERAGE



NEXRAD
DUAL-POLARIZATION UPGRADE STATUS